In figure 2, a part of the product 11 is shown clamped in the corresponding parts of a pair of cooled tools (16, 17) of a press forming machine. The flat cut-to-size sheet is heated in a furnace to a temperature above Ac_3, that is, the austenite area. The heated sheet is moved in between the pair of tools 16, 17 and the tools 16, 17 clamp the sheet and forms it in a rapid forming operation. The forming should be so quick that the steel does not harden during the forming operation. Then, the sheet remains in the cooled tools 16, 17 which serves as a fixture or support or form or brace after the forming and during the cooling. The cooling should be so rapid that the steel will have a suitable martensitic structure as described in GB-1490535-A and the analysis or makeup or composition of the steel should preferably be as described therein.

Around the areas in which the holes 12, 13, 14 are to be made, there are inserts 20, 21, suitably or preferably ceramic inserts, in the tools 16, 17. These inserts 20, 21 have a lower heat conducting ability than the rest of the tools 16, 17 and they cause the sheet to cool more slowly in these areas than otherwise. Thus, the sheet hardens less, that is, is less martensitic, or does not harden at all in these areas.

Then, when the holes 12 - 14 are punched or made in another way, their edges will be more even than they would be if they were punched in a hardened material. There will also be less microcracks. This will have a positive effect on the fatigue strength. The wear of the machining tools will also be reduced which is an advantage economically.

Figure 3 shows tools 16, 17 which have recesses 23, 24 instead of the inserts 20, 21 in Figure 2 so that thin clearances are formed between the tools 16, 17 and the sheet 11 in the areas for subsequent machining, that is in the areas in which the holes 12 - 14 are to be punched. The recesses 23, 24 reduces the cooling effect of the tools 16, 17 and the result will be the same as when the inserts 20, 21 are used, that is, the steel will not transform into martensite at all or will do so at a reduced degree.

Figure 4 shows an alternative design with induction elements 27, 28 in the tools 16, 17. By induction heating, the rapid cooling can be prevented and the steel can be prevented from hardening in the area of the induction elements.

The present invention relates to a method of producing a sheet steel product by heating a sized steel sheet, hot forming the steel sheet in a pair of tools and hardening the formed product by cooling it rapidly from an austenitizing temperature while it is still in the pair of tools and then machining the product.

Background of the Invention:

This method of making hardened sheet steel products is known from GB-149035-A incorporated herein by way of reference and it is called press hardening. A great advantage is that hardened products with complicated form can be produced and still, the tolerances in form and size can be narrow.

In order to reach very high position accuracy of some details, for example holes, slots and the like, a machining operation is carried out on the hardened product. This machining causes high tool wear and may cause reduced fatigue resistance.

Object of the Invention

It is an object of the present invention to improve the method of producing complicated hardened products by press hardening and subsequent machining and to improve the qualities of the products. This is accomplished in principle in that mild areas are left in the product and the machining is carried out in these mild areas. ~~The invention has been given the characteristics stated in the claims.~~

The invention will be described with reference to the accompanying drawings. Figure 1 shows an example of a product produced in accordance with the invention. Figure 2 shows schematically a part of the product shown in Figure 1 clamped in a pair of forming tools. Figures 3 and 4 show schematically the same part of the product as in Figure 2 clamped in modified forming tools.

Description of the Preferred Embodiments

The finished product 11 of thin sheet steel shown in Figure 1 has a complicated form and it has three holes 12, 13, 14 with high demands on accuracy in their positions. The holes 12, 13, 14 can therefore not be made in the flat sheet before the forming but must be made after the forming. The sheet can for example be 1 - 3 mm thick and the product 11 can for example be a safety bar for car doors.

It will also be possible to permit martensite to form and to then temper the formed martensite by heating the steel by the use of the induction elements 27, 28. It is also possible to heat by other methods than induction heating.

As an alternative to the providing of mild steel areas in the steel directly in the forming tools as described with reference to the Figures 2 - 4, one can have the entire product 11 harden in the tools and then, in a separate process, temper the areas in which the machining is to be carried out. In such a case, the tempering can be carried out in direct connection with the machining operation by using a machine, for example a punch, that has a heating device, for example an induction heating element, built into it.